magnetic body belonging to the same said magnetic circuit, and said remaining region of said soft magnetic body possessing in total a larger cross section in direction of the flux than the sum of said teeth that are disposed toward said air gap and that conduct the same magnetic flux in one direction of said magnetic circuit.

REMARKS

This Amendment is in response to the Office Action dated November 14, 2003. Claims 1 - 7 are pending in the application.

Regarding **Claim Rejections - 35 USC § 102(b):**

The examiner rejects claims 1 ~ 3 under 35 USC § 102(b) as being anticipated by Rosenberry (4,392,072).

The applicant clarifies claim 1 by adding the characteristic crystalline to material and by elaborating on the characteristic of the cross section change in the magnetic circuit.

Rosenberry (US 4,392,072) describes exclusively machines in which the stator consists of amorphous metal - that is, in the yoke and in the teeth!

The applicant respectfully points out that amorphous metals have a distinctly lower saturation flux density than crystalline electric sheet. The best amorphous metals achieve maximally 1.61 Tesla (16.1 kGaus). On the other hand, crystalline iron or crystalline cobalt alloys achieve 2 ~ 2.3 Tesla (20 ~ 23 kGaus)!

This is borne out by Ray in US 4,036,638. There, in Table II, column 6, a saturation magnetization of 16.1 kGaus = 1.61 Tesla is given for the alloy composition $Fe_{83}B17$ and $Fe_{80}B20$. An alloy composition with cobalt achieves only 10.8 kGaus = 1.08 Tesla. The saturation magnetization of amorphous cobalt alloys is lower than that of other amorphous alloys. The advantage of amorphous metal is a much lower power loss at high frequencies, but its cost is more than 10 times higher than the cost of crystalline sheet. To this day, these values have not changed.

A person skilled in the art knows that the saturation magnetization of amorphous metals is lower than that of crystalline metals. Even regular electric sheet is very easily magnetizable up to 1.65 Tesla and achieves a saturation magnetization of 1.9 ~ 1.95 Tesla (19 ~ 19.5kGaus).

Amorphous metal is only available in very thin layers which can not be punched. For this reason, Rosenberry suggests to produce the teeth by winding them up (Fig. 4 and Fig. 5). Attachment is problematic so that the amorphous metal is sealed in resin. However, epoxy resin does not conduct magnetic flux. The median saturation magnetization of the part is decreased by its share in the volume. Due to said resin, the teeth in Rosenberry have a lower saturation magnetization than the metal alone.

Amorphous material is mechanically less stable under load. It is therefore not well suited for electric machines with their strongly pulsating magnetic forces, or it will require much resin. Additionally, amorphous metal is noticeably more expensive than electric sheet. The objective of the present invention is to minimize the costs of the electric machine. Since Rosenberry constructs the entire stator of the expensive amorphous material, an approach for a solution would not be obvious for one skilled in the art, which would lead to the solution of claim 1 or claim 6.

Rosenberry teaches also soft magnetic bodies formed of amorphous metal particles and a moulded bonding resin that fixes the particles in a highly compacted relationship with a film resin separating a major portion of the particles from one another. This kind of soft magnetic body has, compared to a crystalline metal, a very high magnetic resistance, because each film of resin between the particles in direction of the magnetic flux increases the magnetic resistance.

Someone skilled in the art knows that materials with high magnetic resistance are not feasible for increasing the power density of an electric machine. Furthermore, the resin-bonded material is even more expensive. The particles are more expensive to produce than the thin ribbon.

In summary: There are four good reasons **not** to use Rosenberry's solution in electric machines,

a) the lower maximum magnetic flux density of the material
b) the high price of the material
c) the complex processing properties of the material
d) the high magnetic resistance of resin-bonded material.

The objective of the applicant is to advance a machine in accordance with the reluctance principle in such a manner that, at reasonable production costs, the torque-to-bore volume ratio in relation to the air gap surface is increased and the ohmic and magnetic losses are decreased.

On the other hand, Rosenberry's objectives are:

a) "...enable the economical and efficient use of amorphous metal alloys in its fabrication..." (column 2, line 45).
b) "...stator construction that can accommodate a variety of tooth configurations..." (column 2, line 48).
c) "...amorphous metal alloy components that are mounted in predetermined fixed relationship and supported therein by bonding..." (column 2, line 55).

Rosenberry describes solutions that realize a stable stator construction from amorphous metal. Flux densities and power densities are not considered! Thus, not only the objectives, but also the solutions are distinctly different from the invention of the applicant.

Since the use of amorphous metals in the yoke <u>and</u> the teeth is fundamental in Rosenberry, the invention of the applicant is neither preempted by nor is it obvious in view of Rosenberry. In order to unambiguously clarify this point, the applicant inserts the characteristic "crystalline material" into independent claim 1.

The fundamental properties and differences between

amorphous metal	-	crystalline metal
amorphous cobalt alloy	-	crystalline cobalt alloy

are to be taken into account in the assessment of the specifications. These differences are known to someone skilled in the art and the applicant respectfully requests to consider these differences in the fabrication as well as the magnetic properties in the examination. The different properties of the material alone inform the person skilled in the art that Rosenberry with his components made of amorphous metal does not show a solution to intensify the flux density in the air gap. Not with one word does Rosenberry mention flux density in the air gap or an attempt to increase the power density of the machine by concentrating the flux density in direction to the air gap.

The characteristic of the present invention -- "said remaining region of said soft magnetic body possessing in total a larger cross section in direction of the flux than the sum of said teeth that are disposed toward said air gap and that conduct the same magnetic flux in one direction of said magnetic circuit" describes exactly this concentration effect. Rosenberry does not mention anything in this regard. The large thickness of the yoke in the drawings shows only that Rosenberry is utilizing low pole machines in which a multitude of grooves are arranged in each pole pitch. The magnetic flux in the yoke is thus distributed over many teeth. Flux concentration is not present and is not intended.

A clear indication of this fact is recognized by a person skilled in the art from the pole shoes which, in fact, enlarge the cross section in direction to the air gap and thus do not increase the flux density in the air gap but rather decrease the same!

The pole shoes are another clear indication that claim 1 of the present invention with the characteristic of flux concentration is not obvious in view of Rosenberry.

May the applicant summarize the arguments once again:

1) Rosenberry utilizes exclusively amorphous metal in the yoke and the teeth.

2) Amorphous metal is much more expensive (> 1000%) than crystalline metal. Therefore, Rosenberry does not show a solution that advances an electric machine at reasonable production costs.

3) Amorphous alloy has distinctly lower saturation flux densities than crystalline alloy. Besides, resin between the flakes or strips of amorphous metal additionally lowers the flux density in the teeth and, thus, also the flux density in the air gap. Therefore, Rosenberry can't decrease the torque-to-bore volume ratio in relation to the air gap surface compared to the conventional electric machine.

4) Rosenberry does not constrict the flux cross section in direction to the air gap, but, in fact, enlarges it by the pole shoes.

These four reasons are clearly recognizable for someone skilled in the art. A solution in accordance with claim 1 of the present invention is not realizable due to the characteristics of the amorphous metal.

It follows that claims 2 and 3 of the present invention which are dependent on claim 1 are also patentable.

Regarding **Claim Rejections - 35 USC § 103(a):**

The examiner rejects claims 4 ~ 6 under 35 USC § 103(a) as being unpatentable over Rosenberry (4,392,072) in view of Kilbourne (2,236,291).

Applicant respectfully refers to the 4 already indicated distinct differences between Rosenberry 4,392,072 and his invention. Since Rosenberry does not impair the independent claim 1, Kilbourne does not require a modification of claims 3 ~ 5.

Kilbourne, published in the year 1939, shows a dynamo-electric machine with broad and narrow pole pieces that are screwed to a tubular frame (yoke). The narrow pole pieces are commutating pole pieces and the broad pole pieces are the main pole pieces. This indicates to someone skilled in the art that Kilbourne

describes a DC-motor. Further, both types of pole pieces are spooled. This is the first difference.

1. **Kilbourne shows no non-spooled half-poles but commutating poles which function only, when they are spooled!**

The size of the commutation pole is distinctly less than one half of the main pole. The flux flows mainly through the main poles and the cross section is constant up to the air gap and larger in the yoke. This is the second difference.

2. **The magnetic flux does not exclusively close in adjacent poles but utilizes also the poles once removed (flux lines go through 2 main poles).**

The poles arranged in direction of the circumference do not touch each other but are fastened to the frame. The magnetic flux in the stator has to flow over assembly gaps twice. This is the third difference.

3. **In the present invention, the magnetic circuit between adjacent poles has only one assembly gap. Kilbourne requires 2!**

Only one commutating pole is arranged between two main poles. On the other hand, in the present invention, two half-pole segments are arranged between two pole segments. This follows directly from the characteristic that each unit consists of one pole segment and two half-pole segments. This is the fourth difference.

4. **In the present invention, the number of half-pole segments is twice that of the number of the pole segments. In Kilbourne the number of the commutating poles is the same as the number of main poles.**

The three objectives named by Kilbourne are also clearly different from the objectives of the present invention and do not suggest the characteristics of claim 6.

Contrary to this state of the art known since 1939, the soft magnetic body of claim 6 of the present invention does not consist of a frame with commutating poles

and main poles, but of pole segments and half-pole segments. One pole segment each together with two adjacent half-pole segments constitute one unit. Several identical units are arranged side by side. Therefore, there are twice as many half-pole segments as pole segments. This new design of the soft magnetic body is being combined with the characteristic that the pole segments consist of grain oriented material.

This combination:

a) Separation of the punched sheet into units consisting of one pole segment and two half-pole segments (and without a frame),

b) Utilization of grain oriented material which is not customary for motors,

is not shown by Kilbourne.

The applicant lists 4 distinct differences which sharply delimit Kilbourne against the independent claim 6 of the present invention.

Neither the Rosenberry nor the Kilbourne document shows the characteristics of claim 1 and claim 6 of the present invention.

Reconsideration and allowance of the application is respectfully requested.

Respectfully submitted,

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